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G. R. Hayes File
Central File

INTEROFFICE CORRESPONDENCE

Date: May 16, 1989
To: R. C. Schmitt
From: G. R. Hayes *GRH*
Subject: NuPAC 125-B O-RING PROBLEM - GRH-24-89

For your information I have prepared the attached fact sheet which explains the O-ring problem. To briefly summarize, Cascade Rubber Company is confident that the incomplete bonding of the butt seams was caused by contamination of the neoprene material.

The O-ring is manufactured by molding 24 inch straight lengths of O-ring material and then using a hot vulcanizing process to joint the ends of the straight sections. A small amount of material is cut from the end of each molded straight section to prepare the ends for vulcanizing. The tool used to "snip" the ends of this neoprene material is also used to cut other gasket material containing silicone. Since silicone acts as a "release agent," we have the most probable cause; silicon contamination of the ends of the neoprene which causes incomplete bonding of the neoprene.

To support the schedule for the next TMI shipment, 17 O-rings have been returned to Cascade. They will repair 16 O-rings (eight for the inner vessel and eight for the outer vessel) by May 16. Additional process controls (i.e., new cutting tool to be used only for this material and handling precautions to avoid oil contamination from bare hands) will be employed. Each joint will be carefully inspected after vulcanizing. Also, EG&G will source inspect all 16 O-rings (scheduled for May 17) and, upon acceptance, the O-rings will be shipped directly to TMI.

When we have completed the above steps, the remainder of the defective O-rings will be repaired and inspected both by Cascade and by EG&G (we may elect to perform receiving inspection at INEL rather than source inspection).

Finally, if long term service is anticipated (beyond the TMI Program), I recommend that the manufacturing process be changed to eliminate the butt joint seams. This would require considerable initial expense (e.g., manufacture of a full length mold), but it would provide an inherently higher quality O-ring and would simplify manufacture and inspection. Cascade expressed interest in developing a seamless O-ring for this application.

jlm

Attachment:
As Stated

ATTACHMENT 1
May 16, 1989
GRH-24-89
Page 1 of 2

NUPAC 125-B O-RING PROBLEM FACT SHEET

Problem Description:

The O-ring butt joints (where individual sections are joined to form the circular seal) show some areas of incomplete bonding. NOTE: The sections are joined using a hot vulcanizing process.

Extent of Problem:

- 5/3/89 Seventy-seven seals were visually inspected at TMI, 50 have at least one butt joint that shows incomplete bonding. Problem is documented on GPUN MNCR 890030.
- 5/3/89 Seven seals were visually inspected at INEL. There were three seals which had seams with incomplete bonding. Problem documented on NCR CR-2924. The attached Receiving Inspection Report (Attachment 2) summarizes the INEL inspections on these O-rings.

Discussion:

These O-rings are manufactured by Cascade Rubber Company. Cascade is a small (about 40 employees) job shop. Their main products are flat molded gaskets and other rubber products. They have been in business since 1946 and a primary supplier to the Boeing Company (commercial and military aircraft) for 40 years. O-ring manufacture is not a significant part of their business, but they were selected by NuPac to furnish the 125-B seals because their BMS-111 neoprene "recipe" (#CG100-111-60) performed as required at low temperatures.

NOTE: NuPac is currently investigating other seal materials as part of the OCRWM work. However, to date there are only two seal materials that have passed performance testing at low temperatures; Cascade neoprene CG100-111-60 and Butyl rubber. The 125-B would require lid and shell modifications in order to use Butyl rubber seals.

Problem Resolution:

On May 11, I met with Cascade Rubber Company and NuPac to discuss the problem. Attendees were:

Mart Terry, President, Cascade Rubber Company
Bob Walker, QA Manager, Cascade Rubber Company
Howard Smith, Corporate QA Manager, Pacific Nuclear Systems, Inc.
Joe Frith, Quality Engineer, NuPac.

I explained our situation with the TMI Program and the importance of correcting the O-ring problems. Cascade people were very cooperative. They explained their process for producing these O-rings.

Cascade management agreed that the O-rings furnished to us are defective and they will correct the problem. They feel confident that they know the cause of the problem. They will verify the cause and will impose additional QA controls to prevent recurrence of the problem. Also, they agreed (actually they suggested) that EG&G perform 100% source inspection.

Most Probable Cause of Problem:

Contamination of the neoprene material resulted in incomplete bonding during the vulcanizing process. Contamination comes from two sources: (1) silicon contamination from the cutting tools, and (2) handling the ends of the O-rings with bare hands. A small amount of material is cut from the end of each molded straight section to prepare the ends for vulcanizing. The tool used to "snip" the ends of this neoprene material is also used to cut other gasket material containing silicone. Since silicone acts as a "release agent," this contamination causes incomplete bonding of the joint.

Corrective Action:

- (1) Cascade will use cutting tool which is not used for any other purpose than cutting this BMS-111 neoprene material.
- (2) Operators will be instructed to avoid touching the ends of the straight sections with bare hands.
- (3) Cascade will inspect all butt joints for complete bonding.
- (4) EG&G will inspect all butt joints for complete bonding. We agreed on acceptance criteria for this inspection. Inspection instructions are attached (Attachment 3).

Update: - May 16, 1989, telecon with Bob Walker

Cascade has verified that silicon contamination caused the problem. O-rings have been reworked and EG&G will perform source inspection on May 17.

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ATTACHMENT 2
MAY 15, 1989
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O-RINGS RECEIVING INSPECTION REPORT

Contract C 89-306722 Cascade Gasket

1. *First Shipment, February 14, 1989

Item 1 - 6 each of 48 89A0151 R
Item 2 - 6 each of 48 89A0152 R

NCR CR-2786 discrepancy cross section dimension was under sized.

With explanation on inspection method, material was accepted.

2. *Second Shipment, March 15, 1989

Item 1 - 42 each of 48 89A0418 (complete)
Item 2 - 42 each of 48 89A0419R

NCR-CR-2798 discrepancy was seal circumference oversized. Of the 42 each, 35 were accepted, 7 each returned to the vendor for replacement.

3. *Third Shipment, April 28, 1989

Item 2 - 7 each of 48

May 3, 1989 call from Glen Hayes on the problem with O-rings at the Island (TMI). A quick check revealed some separation beginning to start. The seven were taken to TAN for evaluation by project personnel, May 4, 1989.

May 10, 1989; NCR CR-2924 written to document problem. Material already returned to the vendor.

SOURCE INSPECTION INSTRUCTIONS

Page 1 of 3

Requisition No.	C89-306722	Rev. No.		Line Item No.		Quantity	1 & 2	Quality Level	A
Procurement/Planning No.		Rev. No.				Dwg. No.	N/A	Rev. No.	
Title/Description	O-ring seals for the NuPac 125-B cask								
Prepared By	G. R. Hayes	Date	5/16/89			Spec. No.	N/A	Rev. No.	
Program Concurrence	A. L. Ayers, Jr.	Date	5/16/89			Test Referral No.	N/A		
						Q.A. Code No.			
						Q.D. Approval			
Char. No.	Inspection Characteristic					Notes Tools		Inspection Status Stamp/Date	QDR No.
	This SII applies to both the inner containment vessel (ICV) and outer containment vessel (OCV) O-rings. The only difference between OCV and ICV O-rings is the length (circumference).								
1	Record below the quantity of O-rings inspected:								
	Type								
	ICV								
	OCV								
2	Measure the cross sectional diameter of each O-ring in at least two different locations. Diameter to be .285 in. - .290 in.								
3	Measure the O-ring diameter. It is acceptable to measure either the diameter or the circumference. Acceptance criteria per table below:								

SOURCE INSPECTION INSTRUCTION

Page 2 of 3

Requisition No.	C89-306722	Rev. No.	Line Item No. 1 & 2	Quantity	Quality Level	A
Procurement/Planning No.		Rev. No.	Dwg. No.	Notes Tools	Inspection Status Stamp/Date	QDR No.
Char. No.	Inspection Characteristic					
3	Measure the 0-ring diameter. It is acceptable to measure either the diameter or the circumference. Acceptance criteria per table below:			Record method used to measure 0-rings.		
	Type	Nom Dia	Circumference			
	ICV	47-5/8" ± 5/8"	147.6" to 151.6"			
	OCV	52" ± 1/2"	161.8" to 164.9"			
4	Visually inspect the 0-rings for surface defects, such as laps, roughness, hollow areas or other blemishes that could affect sealing capability.					
	NOTE: Cosmetic blemishes which are smooth and do not result in a surface discontinuity are acceptable.					
5	Inspect each butt joint (vulcanized seam) as follows:					
	(a) Visually inspect the seam for 100% bonding. Okay to "roll" the 0-ring and bend it to a radius of not less than 2" when performing this inspection.					
	(b) Verify that surface of the joint is smooth and that there are no ridges, misalignment or other blemishes that could					

SOURCE INSPECTION INSTRUCTION

Requisition No.	C89-306722	Rev. No.	Line Item No.	1&2	Quantity	Quality Level	A
Procurement/Planning No.		Rev. No.	Dwg. No.			Rev. No.	
Char. No.	Inspection Characteristics	Notes To	Inspection Status Stamp/Date	QDR No.			
	affect sealing capability. NOTE: Cosmetic blemishes are acceptable.						
6	Verify cleanliness (rings to be free of foreign material).						
7	Verify certificate of conformance which specifically identifies the seal material as Cascade Gasket Company neoprene compound Number CG100-111-60.						
8	Upon completion of this inspection, the seals to be assigned an EG&G QA number.						
9	A copy of this signed off SII and the Cascade Certificate of Conformance to accompany the O-ring shipment. O-rings to be shipped to the following address: EG&G Idaho, Inc., TMI Site Office, Route 441 South, Unit 2, Building 400 Middletown, PA 17057 Attn: S. W. Metzger						